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Chapter one

Geographic Information System (GIS) and Disease Mapping

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Outlines of the presentation

- What IS geographical information system (GIS)?
- Data and information
- Historical development of GIS
- Source of GIS data
- Component of GIS
- Representing geospatial elements
- Coordinate system
- Projection function of GIS
- Errors , and limitation of GIS

What is Geographic Information System (GIS)?

- GIS is one of the very important supportive parts **of public health**
- GIS can locate **disease distribution** and **burden on the earth**.

What is GIS cont'd....

Geographic: relates to places on the Earth's surface

Where something is

What is at a given location

Information System

- manipulate, summarize, query, edit, visualize
- work with information stored in computer database

Definition of GIS

- GIS is a computer based information system designed to accept large volumes of **spatial data** derived from variety of sources and to efficiently **store**, **retrieve**, **analyze**, **model** and **display output** data according to user defined specifications.
- GIS is a set of tools for **collecting**, **storing**, **manipulating**, **transforming** and **display** of **spatial data** from **real world**.
- GIS is a system of **computer software**, **hardware** and **data**, and **personnel** to help **manipulate**, **analyze** and **present information** that is tied to a **spatial location**.

Definition of GIS cont'd...

- “---a system of hardware, software and procedures to facilitate the management, manipulation, analysis, modeling, representation and display of georeferenced data to solve complex problems regarding planning and management of resource.”
- GIS is a system (hardware + database engine) that is designed to efficiently, assemble, store, update, analyze, manipulate, and display **geographically referenced information** (data identified by their locations).
- In short, **GIS** is a system for capturing, storing, checking, integrating, manipulating, analyzing and displaying data which are spatially referenced to the earth.
- GIS is a generic term denoting the use of computers to create and depict **digital representations of the earth's surface**.

What is GIS cont'd...

- GIS links **graphical features** about **where** things are found (*the spatial component or entities*) with tabular data **what** things are like there (*attributes*)

Information System



+

Geographic Position



Data vs Information

- Data by itself, generally differs from information
- **Data is of little use** unless it is transformed into **information**
- Information is **an answer to a question** based on raw data
- GIS can transform **data into information**

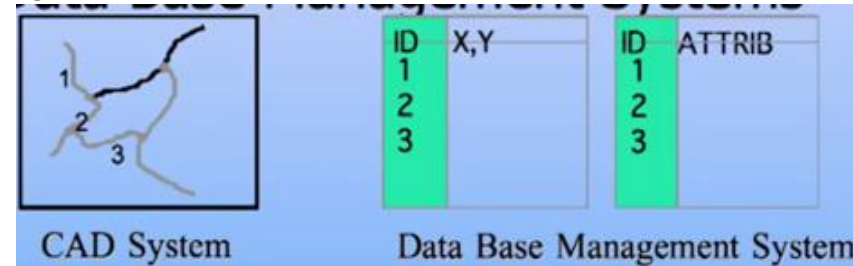


N.B: GIS, GPS & Remote Sensing are generic, spatial and digital technologies

Historical development of GIS

- This technology has developed from:

- ✓ Digital cartography and CAD
- ✓ Database Management System



- The **1st** computerized GIS was evolved in **1964 in Canada**.
- The application was named as Canada Geographic information system (CGIS) which was used to help with regulatory procedures of **land-use management** and **resource monitoring**
- **Roger F. Tomlinson** is the primary originator of modern computerized GIS (**Father of GIS**)

Historical development cont'd....

- While working for the federal government in the 1960s **Dr. Tomlinson** started and directed the development of the Canadian GIS *(the 1st computerized GIS in the world)*
- Jack **Dangermond** (Harvard laboratory for computer graphics) in **1969** Jack co-founded with his wife **Laura** - the Environmental System Research Institute (**ESRI**), a **privately held GIS software company**

John Snow and Cholera

- He was a physician in **1850's London**.
- In 1849 he publishing an essay stating that diseases such as **Black Death** and **cholera** were not caused by *bad air*.
- In 1854 he created a map that showed the relationship between *cholera* and **the public sources of water** in **Soho** England.
- As a result, the local council **deactivated the pump** that was the source of *cholera*.

John Snow and Cholera

GIS concepts are not new!

London cholera epidemic 1854



Why GIS Is Unique?

- GIS handles **Spatial information**
 - ✓ Information referenced by its **location in space**
- GIS makes connections between activities based on **spatial proximity**

What is GIS used for?

Who?

- Government
- Industry
- Academics

What?

- Health
- Hydrology
- Geology
- Crime
- Demographics

Sources of GIS Data

- The most important and expensive component of the GIS is **data** which is generally known as **fuel** for GIS
- GIS data is a combination of **geographic** and **tabular data**
- The data for GIS can be derived from **various sources**
- A wide variety of data sources exist for both **spatial** and **attribute** data
- People can use *topo maps*, *aerial photographs*, *satellite images*, *data ground surveys*, *readily available reports* and *government* or *research publications*.

Sources of GIS Data cont'd....

- The **most common** general sources of **spatial data** are:
 - Hard copy maps;
 - Aerial photo graphs;
 - Remotely-sensed imagery;
 - Point data, samples from surveys;
 - Existing digital data files, and
 - Existing hardcopy maps, e.g. sometimes referred to as **analog maps**, provide the most popular source for any GIS project

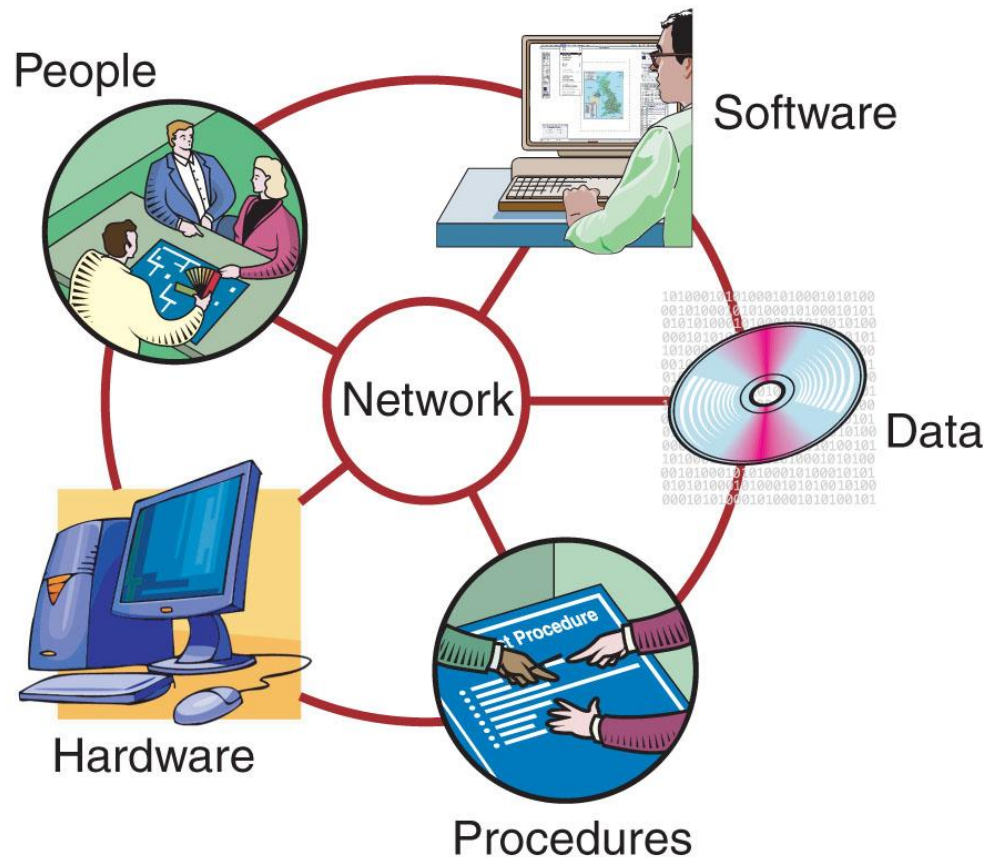
Sources of GIS Data cont'd....

- **Attribute data** has an even wider variety of data sources.
- They are: **GIS data from libraries**
- Data from **National and International Mapping Agencies**

Components of GIS

GIS is an organized collection of computer hardware, software, geographic data, procedures, and personnel designed to handle all phases of geographic **data capture, storage, analysis, query, display, and output**

Six parts of a GIS



Components of GIS cont'd....

1. People

- ✓ GIS technology is limited without the people who manage the system and develop plans for applying it to real-world problems
- ✓ GIS users range from **technical specialists** who design and maintain the system to those who use it to help them **to perform their everyday work**
- ✓ Are the most important part of a GIS
- ✓ **Define** and **develop** the procedures used by GIS
- ✓ Can overcome shortcomings of the other 4 elements (data, software, hardware and procedure), but not vice versa

Components of GIS cont'd....

2. Hardware

- ✓ Hardware is the computer on which a GIS operates.
- ✓ Today, GIS software runs on a wide range of hardware types, from **centralized computer servers** to **desktop computers** used in stand-alone or networked configurations.

Components of GIS cont'd....

3. Software

- ✓ GIS software provides the functions and tools needed to **store**, **analyze** and **display** geographic information

Key software components are:

- ✓ Tools for the input and manipulation of geographic information
- ✓ A database management software (DBMS)
- ✓ Tools that support geographic query, analysis and visualization
- A graphical user interface (GUI) for easy access tools

Components of GIS cont'd....

4. Data

- ✓ Possibly the most important component of GIS is the data
- ✓ **Geographical data** and **related tabular data** can be collected in-house or purchased from a commercial data provider

Components of GIS cont'd....

5. Methods / Procedures

- ✓ A successful GIS operates according to a **well-deigned plan** and **business rules**, which are the models and operating practices unique to each organization

Functions of GIS

There are **three main** functions of GIS:

- Geographic **data management**
- Mapping and **Visualization**
- **Spatial Analysis**



Functions of GIS cont'd...

- **Mapping Data**:- the central function of a geographic information system is to provide a **visual representation** of the data
- GIS provide a means for that data to be stored in database and then represented visually in a **mapped format**.
- **Proximity Analysis**: a proximity analysis is an analytical technique that is used to define the relationships between a **specific location** and **other locations** or points that are created in the same way
- It is used by many commercial organizations to identify sites suitable for business outlets

Functions of GIS cont'd...

- **Buffering**:- is a technique buffering which is commonly used with **proximity analysis** to indicate the sphere of influence of a given point.
- **Buffering** involves creating to a **zone around a given point**, line or polygon of specified distance.
- For example, a **1000m buffer** could be generated around a school to then overlay analysis to find out how much libraries are with in **1000m** of that school.

Thank you!

Lab demonstration 1

- Add the regional, zonal, and woreda administrative boundaries of Ethiopia.
- Right-click on the zone
- Open attribute table
- Select Majang zone
- Create a layer for the selected zone. Hint: go to selection
- Change the name of the selected zone. Hint: go to properties
- Fill it with “lake” color, make line width 1, and make the outline color green.

Lab demonstration 2

- Add the regional, zonal, and woreda administrative boundaries of Ethiopia.
- Right-click on the zone
- Open attribute table
- Select Illubabur zone
- Create a layer for the selected zone. Hint: go to selection
- Change the name of the selected zone. Hint: go to properties
- Fill it with “Sun” color, make line width 1, and make the outline color black.